DESIGN OF R.C.C. STRUCTURES
(CIVL 3105)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The value of partial safety factor for steel is
(a) 1.5 (b) 1.2 (c) 1.15 (d) 1.25.

(ii) The coefficient of thermal expansion of concrete is nearly equal to that of
(a) Wood (b) Aluminium
(c) Steel (d) Copper.

(iii) The yield stress divided by the factor of safety is called as
(a) Ultimate stress (b) Limit stress
(c) Elastic stress (d) Permissible stress.

(iv) A member, built in to masonary wall which develops only partial restraint, shall be designed to resist a negative moment at face of the support of
(a) Wl/12 (b) Wl/10 (c) Wl/24 (d) Wl/16
where l is the effective span and W is total load on one span.

(v) Dog-legged stairs are designed similar to
(a) One way slab (b) Two way slab
(c) T-beam (d) L-beam.

(vi) The final deflection due to all loads including the effects of temperature, creep and shrinkage should not normally exceed
(a) span/250 (b) span/350
(c) span/150 (d) 20 mm.

(vii) Over continuous edge tension reinforcement provided at the middle span in the middle strip shall extend in the lower part of the slab to within
(a) 0.15 l (b) 0.30 l (c) 0.25 l (d) 0.10 l
where l is the unsupported span of the slab

(viii) As per IS 456-2000 shear reinforcement can be provided in the form of
(a) vertical stirrups (b) bent up bars
(c) inclined stirrups (d) all of these.

(ix) As per IS 1906:1986 factor of safety for the stability of foundation against sliding shall not be less than
(a) 1.75 (b) 2.0 (c) 2.5 (d) 1.5.

(x) To give protection against spalling nominal cover to beam required shall exceed
(a) 20 mm (b) 15 mm (c) 35 mm (d) 40 mm.

Group – B

2. (a) A reinforced concrete beam of 300 mm width and 600 mm effective depth is reinforced with 4-25 φ bars. Assuming M20 grade concrete and Fe 415 grade steel, determine the allowable bending moment and the stresses in concrete and steel corresponding to this moment. Use working stress method of design.

(b) Determine the area of reinforcement required for a singly reinforced concrete section having a breadth of 300 mm and an effective depth of 600 mm to resist a factored moment of 200kN-m. Adopt f_{ck} = 20N/mm^2 and f_y = 415N/mm^2.

6 + 6 = 12

3. (a) What are the different types of reinforcements used to resist the shear forces developed in reinforced concrete members?

(b) A reinforced concrete cantilever beam of rectangular section 300 mm wide by 600 mm deep is built into a column 500 mm wide. The cantilever beam is subjected to a hogging moment of 200kN-m at the junction of beam and column. Design suitable reinforcement in the beam with required anchorage length. Adopt M20 grade concrete and Fe415 HYSD bars.

3 + 9 = 12

Group – C

4. (a) Determine the depth of neutral axis and ultimate moment of resistance for the beam section of width 250 mm and effective depth 500 mm reinforced with 4 nos. of 20 mm diameter bars using limit state method of design. Assuming M20 grade of concrete and Fe415 grade of steel.

(b) A rectangular reinforced concrete beam is simply supported with an effective length of 5.5 m. The beam has to carry, in addition to its own weight, a distributed live load of 12 kN/m and a dead load of 8 kN/m. Design the flexural reinforcement for the beam such that its size is limited to 250 mm width and effective depth of 350mm for maximum moment at mid span. Assuming M25 grade of concrete and Fe500 grade of steel.

5 + 7 = 12

5. (a) Classify the different cases of analysis for an under reinforced T-beam with flow chart.

(b) Design and detail a one way slab, with effective span of 4.0 m, simply supported on brick walls, and subjected to a live load of 3.5kN/m^2 and a surface finish 1kN/m^2. Assume Fe415 steel and M25 grade of concrete.

3 + 9 = 12

Group – D

6. Design a dog-legged staircase (waist slab type) for an office building assuming floor to floor height of 3m.
Width of flight = landing width = 1.2m. Adopt a tread to be 300 mm and rise to be 150 mm. Use M20 grade concrete and Fe415 HYSD bars. The live load is 5kN/m^2. Assume the landings to be supported only on two edges perpendicular to the risers.

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7. (a) Design the longitudinal reinforcement in a rectangular reinforced concrete column of size 300mm × 600mm subjected to a factored load of 1400 kN and a factored moment of 280kNm with respect to the major axis. Use M20 concrete and Fe 415 steel.

(b) A corner column (400mm × 400mm), located in the lowermost storey of a system of braced frames, is subjected to factored loads: P_u = 1300 kN, M_{ux} = 190 kNm and M_{uy} = 110 kNm. The unsupported length of the column is 3.5 m. Design the reinforcement in the column, assuming M25 concrete and Fe415 steel.

5 + 7 = 12

Group – E

8. Design an isolated footing for a column of 300mm × 500mm, reinforced with 6-25φ bars with Fe415 and M25 concrete subjected to a factored axial load

of 1000 kN and factored uniaxial moment of 125 kN-m (with respect to major axis) at column base. Assume that the moment is reversible. Unit weight of soil = W_e = 19kN/m^3. Angle of repose = φ = 30°.
Safe bearing capacity of soil q = 200kN/m^2 at depth 1.5m below ground. Use M20 concrete and Fe 415 steel.

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9. Design a suitable pile cap for a reinforced concrete column of size 500 mm × 500 mm, reinforced with 8-25φ bars, carrying a factored axial load of 4000kN, supported by four symmetrically placed piles, 300 mm diameter, spaced at 1.2 m in both x and y directions. The pile location tolerance may be taken as 50 mm. The column and piles are with M30 concrete and use M25 concrete for the pile cap. Use Fe415 steel.

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